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NAVAL PERSONNEL RESEARCH AND DEVELOPMENT LABORATORY

WRR 70-7

MARCH 1970

PREDICTION OF SUCCESS IN THE U. S. NAVAL PREPARATORY SCHOOL

DDC
MAR 31 1970

BY

WILLIAM A. SANDS

WASHINGTON NAVY YARD
WASHINGTON, D.C. 20390

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MARCH 1970

PREDICTION OF SUCCESS IN THE U. S. NAVAL PREPARATORY SCHOOL

(PF39.521.001.02.02)

BY

WILLIAM A. SANDS

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NAVAL PERSONNEL RESEARCH AND DEVELOPMENT LABORATORY
WASHINGTON, D. C. 20390

A LABORATORY OF THE BUREAU OF NAVAL PERSONNEL

FOREWORD

This study was accomplished under Work Unit PF39.521.001.02.02.

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SUMMARY AND CONCLUSIONS

Problem

The Naval Preparatory School (NPS) serves both as a preliminary training program to prepare enlisted candidates for officer training, and as a situational screen to eliminate those whose academic capacity is inadequate. Much concern has been expressed over the high attrition rate of enlisted men selected for NPS, and among NPS graduates at the Naval Academy. The Naval Personnel Research and Development Laboratory is responsible for investigating the effectiveness of the NPS system, particularly with regard to selection of enlisted candidates for NPS, and eventual acceptance by the Naval Academy. The objective of the investigation is to assess and improve the effectiveness of the current NPS selection procedures.

Background and Requirements

The mission of NPS is to provide intensive instruction designed to prepare potential U. S. Naval Academy (USNA) applicants from the Regular and Reserve Navy and Marine Corps with the requisite skills for matriculation in, and satisfactory completion of, the USNA curriculum.

Although most of the attrition occurs early from both NPS and USNA, it represents an estimated annual loss to the Navy of between one and three million dollars.

In order to reduce these financial losses and to aid in the procurement of an adequate number of well-trained Naval Officers, the Assistant Chief for Education and Training (Pers-C) requested the Assistant Chief for Plans and Programs (Pers-A) to initiate the present study.

Approach

The predictor variables were all measures of scholastic ability and/or achievement. The operational predictors consisted of five measures of high school academic performance and the School and College Ability Tests. These seven variables were combined into the Current NPS Selection Composite. Four experimental predictors were also examined: the English and mathematics achievement tests of the College Entrance Examination Board; and, the verbal and mathematics sections of the Scholastic Aptitude Tests. Two criteria were employed: NPS Final Grade Average (FGA); and, USNA Selection vs. Rejection (S/R).

The applicant sample consisted of 246 persons eligible for the 1966-67 NPS program. The selectee sample consisted of those 113 persons accepted by NPS.

Correlation and regression analyses were performed against each of the two criteria for the Current NPS Selection Composite and the operational and experimental predictors described above, taken individually and in various combinations.

Major Findings

1. The predictive validities of the Current NPS Selection Composite (FGA: $\underline{r}$ = .643, and S/R: $\underline{r}_{pb}$ = .402) are moderately high.

2. The predictive validities of the optimally-weighted combinations of operational predictors (FGA: $\underline{R}_c$ = .733, and S/R: $\underline{R}_c$ = .398) are higher than, or equal to, those of the Current NPS Selection Composite, while requiring less administrative time and effort.

3. The predictive validities of the optimally-weighted combinations of operational and experimental predictors (FGA: $\underline{R}_c$ = .871, and S/R: $\underline{R}_c$ = .655) are higher than those based upon the best combination of operational predictors, and are considerably higher than those of the Current NPS Selection Composite, while requiring less administrative time and effort.

Conclusions

1. The optimally-weighted composites, especially those based upon operational and experimental predictors, are more efficient than the Current NPS Selection Composite.

2. Although the multiple validity coefficients reported above ($\underline{R}_c$) have been corrected for shrinkage, some additional reduction in the magnitude of the coefficients is expected when these optimally-weighted composites are employed in another NPS applicant sample. However, it seems likely that these optimally-weighted composites will sustain their advantage over the Current NPS Selection Composite in predictive validity.

Recommendations

1. Data should be required for all eligible NPS applicants on the following tests: (a) School and College Ability Tests; (b) English and mathematics achievement tests of the College Entrance Examination Board; and, (c) Scholastic Aptitude Tests. (Pages 6-9)

2. The set of optimal composites based upon operational and experimental predictors should be adopted as a replacement for the Current NPS Selection Composite. This should improve the "batting average" of selection decisions, when used in conjunction with other information considered pertinent by the NPS Selection Board. (Page 9)

3. Follow-up studies are required, as the necessary data become available, to: (a) cross-validate the results reported herein; and (b) to validate the predictors against more ultimate criteria of success like performance in, and graduation from the USNA program, and subsequent on-the-job performance. (Page 10)

4. Additional recruitment efforts would help to insure the improvement of the current selection ratio, thereby making it possible to take maximum advantage of the predictive validity of the composites. (Pages 6-9)

5. The procedures involved in computing and using any of the alternative selection strategies, while not complex, are tedious. In order to minimize the time and effort required of NPS administrative personnel, development and utilization of EDP procedures is mandatory. Once operational, computer-assisted selection would enable the NPS Selection Board to focus on the background characteristics of applicants which are difficult to quantify. (Pages B-1 - B-12)

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BACKGROUND

Each year, the Secretary of the Navy may appoint to the U. S. Naval Academy (USNA) 85 enlisted men from each of the following sources: (a) Regular Navy and Marine Corps; and (b) Naval Reserve and Marine Corps Reserve. In order to compete for these appointments, all applicants in the first group must attend the U. S. Naval Preparatory School (NPS), Bainbridge, Maryland. A limited number of openings in the NPS program are available for applicants in the second group (10).[1]

The mission of NPS is to provide a course of intensive instruction designed to prepare potential USNA applicants with the requisite skills for matriculation in, and successful completion of, the rigorous USNA program (2, 11).

The NPS and USNA programs represent a considerable investment by the Navy. For each candidate, the costs of these educational programs are approximately $4,000 and $34,000, respectively (9). The attrition rate between NPS matriculation and USNA graduation is alarmingly high. Using average figures based upon the USNA classes of 1962-1965, only 61% of those selected for NPS successfully completed the program. An average of 48% of the original NPS selectees were found to be qualified for USNA entrance and only 41% of the original group entered USNA (1). Finally, only 18% of the original group of NPS selectees graduated from USNA. This represents a total attrition rate of 82%. Despite the fact that most dropouts occur early in these educational programs, the annual loss to the Navy occasioned by this high rate of attrition is between one and three million dollars (9).

In order to decrease these financial losses and to aid in the procurement of an adequate number of well-trained Naval Officers, the Assistant Chief for Education and Training (Pers-C) requested the Assistant Chief for Plans and Programs (Pers-A) to initiate the present study (1).

PURPOSE

This investigation is the first in a series of studies designed to assess and improve the efficacy of the current NPS selection strategy. The purpose of this report is to inform a general audience of the results obtained to date. Another, more technical report (8) describes the methodology and results of the various statistical analyses in greater detail.

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[1] All underlined numbers enclosed by parentheses refer to corresponding numbers of documents listed under References.

METHOD

Variables

The name, abbreviation,[2] and definition of each of the variables are as follows:

Operational Predictor Variables[3]

Data on these variables were available to the NPS Selection Board prior to selection decisions.

(1) Major Subject Unit Score (MSU) - The number of one year, college preparatory courses passed (a grade of C or higher) in the following subjects: English; algebra; plane geometry; solid geometry; trigonometry; chemistry; and physics.

(2) Optional Subject Unit Score (OSU) - The number of one year college preparatory courses passed (a grade of C or higher) in the following subjects: Latin; modern language; social studies; and, sciences and mathematics courses not considered MSU.

(3) Major Subject Quality Score (MSQ) - A score which describes the grades earned in the MSU, as follows: "A"=4; "B"=3; "C"=2; "D"=0; and "F"=0.

(4) Optional Subject Quality Score (OSQ) - A score which describes the grades earned in the OSU, as follows: "A"=4; "B"=2; "C"=1; "D"=0; and, "F"=0.

(5) High School Completion Score (HSC) - A score of 15 is assigned to high school graduates, while non-graduates receive a score of zero.

(6) SCAT Verbal Ability Raw Score (SVAR) - The number of questions answered correctly on the verbal section of the Cooperative School and College Ability Tests.

(7) SCAT Verbal Ability Converted Score (SVAC) - The converted score assigned to SVAR.

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[2] Abbreviations for the variable names will be employed throughout the report.

[3] Raw scores on the two SCAT variables were employed in the Current NPS Selection Composite. However, only the two corresponding converted scores were used in the statistical analyses (3, 4).

(8) SCAT Quantitative Ability Raw Score (SQAR) - The number of questions answered correctly on the quantitative section of the Cooperative School and College Ability Tests.

(9) SCAT Quantitative Ability Converted Score (SQAC) - The converted score assigned to SQAR.

Experimental Predictor Variables

Data on these variables were obtained on NPS selectees about midway through the academic year. Therefore, this test information was not available for use by the NPS Selection Board in making selection decisions.

(1) CEEB English Achievement Score (CBEA) - The converted score obtained on the English Comprehension achievement test of the College Entrance Examination Board.

(2) CEEB Mathematics Achievemer core (CBMA) - The converted score obtained on the Intermediate Mat atics achievement test of the College Entrance Examination Board.

(3) SAT Verbal Aptitude Score (SATV) - The converted score obtained on the verbal section of the Scholastic Aptitude Tests.

(4) SAT Mathematics Aptitude Score (SATM) - The converted score obtained on the mathematics section of the Scholastic Aptitude Tests.

Selection Composite

This combination of seven operational predictors was employed in selecting NPS applicants in the 1966-67 academic year.

(1) Current NPS Selection Composite (CSC) - The sum of MSU, weighted by two, plus the sum of OSU, MSQ, OSQ, HSC, SVAR, and SQAR.

Criterion Variables

Data on these two variables were available for all persons selected for the NPS program.

(1) NPS Final Grade Average (FGA) - The final grade average obtained in the NPS program.

(2) USNA Selection vs. Rejection (S/R) - A score which expresses the U. S. Naval Academy admission status: selectees were assigned a score of one, while rejectees received a score of zero.

Samples

Applicant Sample

This sample of 246 consists of eligible NPS applicants for the 1966-67 academic year. In order to be considered an "eligible" applicant, a person had to possess a number of requisite qualifications delineated elsewhere (2).

Selectee Sample

This sample of 113 consists of eligible applicants (as described above) who were selected for admission to NPS, matriculated, and remained in the program for at least one marking period.

Data Analyses

Correlation Analyses

Means (average score), standard deviations (a measure of dispersion, indicating the scatter of scores about the mean), and intercorrelations[4] for the operational predictor variables were computed in the applicant sample. Since data on all applicants were not available for the four experimental predictor variables and the two criterion variables, the statistics involving these variables were estimated using techniques described elsewhere (6, pp. 413-417).

Regression Analyses

Multiple regression analyses of the operational predictor variables were performed against each of the two criteria. In addition, multiple regression analyses incorporating the operational and experimental predictor variables were made.

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[4] A correlation coefficient describes the degree of association or linear relationship between two variables. A perfect relationship yields a correlation of plus or minus one, while the absence of any relationship is indicated by a correlation of zero. If the two variables are directly related, the sign of the correlation if positive; a negative correlation indicates an inverse relationship.

RESULTS AND INTERPRETATION[5]

The intercorrelations, means, and standard deviations of all variables in the NPS applicant sample are presented in Table A-1 of Appendix A. Table A-2 presents the same information computed in the sample of NPS selectees.

The appropriate weights for the alternative selection composites and procedures for employing them to estimate criterion scores (FGA and S/R) for NPS applicants are explained in Appendix B.

The validity coefficient (a correlation between a criterion and a predictor or composite of predictors) constitutes the basis for evaluating the various predictors as potential replacements for CSC.

Criterion data (FGA and S/R) were not available for those persons rejected by NPS. The validity coefficients of the individual predictors and CSC were computed in the sample of NPS selectees. Since the selectees cannot be considered a representative sample of NPS applicants, the validity coefficients were corrected to provide better estimates of the value of the predictors for making selection decisions in the NPS applicant group.

Validity of the Current NPS Selection Composite

The best available estimate of the validity of CSC for predicting FGA in the NPS applicant sample is .643, as shown in Table 1. The corresponding validity of this composite for predicting S/R for NPS applicants is .402. These validity estimates constitute the standard against which the validity of the various predictors, taken singly and in combination, can be evaluated.

Validity of the Operational Predictors

As shown in Table 1, SQAC and MSQ are the two most effective single operational predictors for forecasting FGA for NPS applicants (r = .615 and .590, respectively). The same two operational predictors are also the most predictive of S/R (r_{pb} = .337 and .349, respectively).

None of the operational predictors, taken alone, is as effective as CSC for predicting FGA (r = .643) or S/R (r_{pb} = .402). This finding is not surprising since CSC utilizes information contained in seven operational predictors.

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[5] The multiple validity coefficients have been corrected for shrinkage (R) (5, p. 401). They represent the best available estimate of the validities to be expected in future NPS applicant samples.

TABLE 1

Validity of the Individual Predictors and the Selection Composite for NPS Applicants (N=246)[a]

Predictor Variables	Criterion Variables FGA	S/R
Operational Predictors:		
MSU	.512	.308
OSU	-.021	.012
MSQ	.590	.349
OSQ	.447	.203
HSC	.055	.030
SVAC	.263	.213
SQAC	.615	.337
Experimental Predictors:		
CBEA	.561	.454
CBMA	.730	.509
SATV	.496	.364
SATM	.770	.623
Selection Composite:		
CSC	.643	.402

[a]The validity coefficients of the individual predictors as well as the CSC were estimated (6, pp. 415-417).

Validity of the Experimental Predictors

The two best experimental predictors for forecasting FGA for NPS applicants are SATM (r = .770) and CBMA (r = .730), as shown in Table 1. The same two experimental predictors are also the best predictors of S/R (r_{pb} = .623 and .509, respectively). They both exceed CSC and all the operational predictors, taken individually, in predictive validity for both criteria.

Multiple Validity of the Operational Predictors

As shown in Table 2, the best combination of operational predictors for forecasting FGA consists of three predictors: MSQ, OSQ, and SQAC.

This combination of three operational predictors, when properly weighted, appears to be more effective ($_{c}R$ = .733) than CSC (r = .643).

TABLE 2

Components and Predictive Validity of the Alternative Selection Composites for Forecasting NPS Final Grade Average for NPS Applicants[a] (N=246)

Components of the Alternative Selection Composites	Predictive Validity for FGA
Current NPS Selection Composite:	r = .643
1. MSU	
2. OSU	
3. MSQ	
4. OSQ	
5. HSC	
6. SVAR	
7. SQAR	
Optimal Composite of Operational Predictors:	$_{c}R$ = .733[b]
1. MSQ	
2. OSQ	
3. SQAC	
Optimal Composite of Operational and Experimental Predictors:	$_{c}R$ = .845[b]
1. MSQ	
2. OSQ	
3. CBEA	
4. CBMA	
5. SATM	

[a]These validity coefficients represent the best available estimates.

[b]The multiple validity coefficients have been corrected for shrinkage ($_{c}R$) (5, p. 401). As such, they represent the best available estimate of the validities to be expected in future NPS applicant samples.

Two of these same operational predictors, MSQ and SQAC, make up the best combination for predicting S/R for NPS applicants ($_cR$ = .398), as shown in Table 3. This represents about the same predictive efficiency as CSC (r = .402).

TABLE 3

Components and Predictive Validity of the Alternative Selection Composites for Forecasting USNA Selection vs. Rejection for NPS Applicants[a]
(N=246)

Components of the Alternative Selection Composites	Predictive Validity for S/R
Current NPS Selection Composite:	r_{pb} = .402
1. MSU	
2. OSU	
3. MSQ	
4. OSQ	
5. HSC	
6. SVAR	
7. SQAR	
Optimal Composite of Operational Predictors:	$_cR$ = .398[b]
1. MSQ	
2. SQAC	
Optimal Composite of Operational and Experimental Predictors:	$_cR$ = .633[b]
1. CBEA	
2. SATM	

[a]These validity coefficients represent the best available estimates.

[b]The multiple validity coefficients have been corrected for shrinkage ($_cR$) (5, p. 401). As such, they represent the best available estimate of the validities to be expected in future NPS applicant samples.

It appears that the availability and proper utilization of information on these three operational predictors (MSQ, OSQ, and SQAC) will allow the accuracy of predictions of S/R to be approximately maintained and will increase the accuracy of predictions of FGA for NPS applicants over that afforded by CSC, which requires information on seven operational predictors.

Multiple Validity of the Operational and Experimental Predictors

The best combination of operational and experimental predictors for forecasting FGA for NPS applicants, as shown in Table 2, consists of five predictors: MSQ, OSQ, CBEA, CBMA, and SATM. This combination of five operational and experimental predictors, when properly weighted, appears to be considerably more effective ($_{c}R$ = .845) than CSC (r = .643).

Two of the experimental predictors, CBEA and SATM comprise the most promising composite for the prediction of S/R for NPS applicants ($_{c}R$ = .633), as shown in Table 3. While none of the operational predictors appear to enhance the prediction of this criterion, it should be noted that it appears to offer considerable improvement over CSC (r_{pb} = .402).

Comparison of Alternative Prediction Composites

In addition to CSC, two alternative selection composites for each of the two criteria have been discussed: (1) the optimal composite of operational predictors; and, (2) the optimal composite of operational and experimental predictors.

Prediction of FGA or S/R for a specific individual applicant based upon the various prediction composites will exhibit some variation. The predictions based upon CSC are the least accurate, while predictions based upon the optimal composite of operational and experimental predictors are the most accurate.

Predictions for Future NPS Applicants

Forecasts of FGA and S/R for a particular individual applicant to a future NPS class can be quite erroneous, regardless of the prediction composite employed. However, predictions for an entire applicant group based upon the optimal composite of operational, or operational and experimental predictors will, on the whole, be more accurate than those based upon CSC. That is, the overall "batting average" for NPS selection decisions will be improved by the adoption of either set of optimal composites.

DISCUSSION

The Current NPS Selection Composite employs weights for the seven operational predictor variables which are not optimal. Therefore, it

is not surprising that the regression composites of operational predictors: (1) had the same or higher validity for predicting FGA and S/R for NPS applicants; and, (2) required information on fewer operational predictors. This was to be expected.

The generally high magnitude of the multiple validity coefficients for FGA, particularly of the optimal selection composite employing the operational and experimental predictors, is very encouraging. These multiple validities, although inflated to some degree, compare quite favorably to the validity of CSC. Moreover, they are substantially higher than those found in similar studies. Lavin (1965), in a comprehensive review of the literature, reports that the average multiple validity of a battery of predictors designed to forecast college grade average is about .65 (7, p. 52).

The multiple validity coefficients for S/R are also quite promising. Although likewise inflated to some degree, they compare favorably with the validity of CSC. The potential contribution of the experimental predictors to NPS selection procedures is particularly evident for this criterion.

It should be noted that the validities of the various composites for predicting S/R are considerably lower than the validities of the composites for predicting FGA. This difference is probably a function of a number of considerations. S/R is a more complex criterion than is FGA. Selection decisions for USNA applicants are based upon a host of different factors, some of which (e.g., athletic prowess) are beyond the scope of the present study. The statistical coding used to quantify this measure of success (S/R) also contributed to the discrepancy (5, pp. 324-325).

In order to insure the stability of the results, a cross-validation study should be done. In addition, the operational and experimental predictors should be validated against more ultimate criteria (e.g., USNA grade average and graduation vs. attrition) as the necessary data become available.

In view of the demonstrated potential utility of the experimental predictors (CBEA, CBMA, SATV, and SATM), the desirability of obtaining these test data for use in future NPS selection decisions should be assessed in terms of the following considerations: (1) the potential reduction in the current attrition rate and the concomitant financial losses to the Navy; and, (2) the cost and administrative effort involved in obtaining this additional information for all eligible NPS applicants.

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APPENDIX A

RESULTS OF CORRELATION ANALYSES

TABLE A-1

Intercorrelations, Means, and Standard Deviations of All Predictor and Criterion Variables in the NPS Applicant Sample (N=246)

Variable	Intercorrelations													Mean	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13		
1. MSU	...	-.010	.898	.335	.037	.173	.379	.339	.442	.330	.436	.512	.308	6.52	1.74
2. OSU		...	-.029	.337	.170	.090	-.079	.178	-.187	.116	-.033	-.021	.012	6.69	0.77
3. MSQ			...	.518	-.010	.198	.423	.433	.458	.359	.470	.590	.349	17.08	6.05
4. OSQ				...	-.013	.209	.191	.399	.173	.380	.273	.447	.203	12.37	4.36
5. HSC					...	-.069	.072	-.090	-.051	-.128	-.016	.055	.030	14.57	2.49
6. SVAC						...	.313	.674	.333	.835	.375	.263	.213	305.17	10.16
7. SQAC							...	.471	.618	.459	.660	.615	.337	317.43	11.22
8. CBEA								...	.406	.744	.550	.561	.454	557.96	80.48
9. CBMA									...	.430	.803	.730	.509	631.27	84.86
10. SATV										...	.522	.496	.364	550.83	88.24
11. SATM											...	.770	.623	626.85	79.17
12. FGA												...	.670	73.99	8.45
13. S/R													...	0.66	0.45

Notes.--1. These statistics represent the best available estimates of those to be expected in future NPS applicant samples.

2. The statistics involving the experimental predictors (variables 8, 9, 10, and 11) and the criteria (variables 12 and 13) have been estimated using techniques described elsewhere (6, pp. 413-417).

TABLE A-2

Intercorrelations, Means, and Standard Deviations of All Predictor and Criterion Variables in the NPS Selectee Sample (N=113)

Variable	Intercorrelations													Mean	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13		
1. MSU	...	-.023	.850	.288	.066	-.037	.244	.133	.327	.102	.289	.423	.238	7.21	1.37
2. OSU		...	-.057	.313	.259	.147	-.071	.142	-.243	.070	-.086	-.086	-.025	6.68	0.86
3. MSQ			...	.500	-.043	-.025	.308	.245	.342	.125	.325	.508	.279	19.75	5.43
4. OSQ				...	.020	.091	.156	.248	.023	.212	.116	.349	.122	13.27	4.84
5. HSC					...	-.118	-.012	-.173	-.107	-.225	-.080	.015	.005	14.60	2.41
6. SVAC						...	.235	.584	.203	.785	.227	.140	.137	306.97	10.29
7. SQAC							...	.318	.549	.289	.581	.550	.274	320.65	9.67
8. CBEA								...	.302	.677	.455	.453	.382	583.47	72.10
9. CBMA									...	.325	.774	.687	.457	651.93	79.84
10. SATV										...	.415	.362	.272	580.59	77.75
11. SATM											...	.723	.580	649.13	72.74
12. FGA												...	.633	76.19	7.82
13. S/R													...	0.73	0.44

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APPENDIX B

PROCEDURES FOR PREDICTING CRITERION SCORES

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IMPLEMENTATION OF A SELECTION COMPOSITE

The actual implementation of the alternative NPS selection composites entails a number of requisite steps:

(1) Obtaining and coding information on an applicant's high school record and computing scores on the operational predictors;

(2) Obtaining the required standardized test score information on an applicant;

(3) Forecasting criterion performance for the applicant, using his scores on the predictors and one of the sets of alternative composites; and,

(4) Making an admissions decision (selection vs. rejection) for an NPS applicant based upon his predicted performance on the criteria and other information considered pertinent by the NPS Selection Board.

COMPUTATION OF OPERATIONAL PREDICTOR SCORES FROM HIGH SCHOOL RECORD

In order to provide a concrete illustration of the procedures involved in coding information contained in a high school transcript, the academic record of a typical NPS applicant is presented in Table B-1.

Equations for computing the scores on the operational predictors are as follows:[1]

Major Subject Unit Score

$$[1] \quad MSU = MSU_A + MSU_B + MSU_C$$

This applicant's score would be:

$$MSU = 1.5 + 2.5 + 2.0$$

$$= 6.0$$

---

[1] The subscripts in the various equations represent letter grades obtained in the courses.

TABLE B-1

High School Achievement Data on A Typical NPS Applicant

	Number of Academic Units, by Grade				
	A	B	C	D	F
Major Subjects:					
English	1.0	1.0	0.5	0.5	
Algebra	0.5		0.5		
Plane Geometry		0.5	0.5		
Solid Geometry				0.5	
Trigonometry					
Chemistry		0.5	0.5		
Physics		0.5			
Totals	1.5	2.5	2.0	1.0	0.0
Optional Subjects:					
Latin		1.0	1.0	0.5	0.5
Modern Language		0.5	0.5		
Social Studies	0.5	1.5	1.0		
Other		0.5	0.5	1.0	
Totals	0.5	3.5	3.0	1.5	0.5
High School Graduation:					
Completed high school?	Yes				

Optional Subject Unit Score

[2] $OSU = OSU_A + OSU_B + OSU_C$

This applicant's score would be:

$$OSU = 0.5 + 3.5 + 3.0$$

$$= 7.0$$

Major Subject Quality Score

[3] $MSQ = 4(MSU_A) + 3(MSU_B) + 2(MSU_C)$

This applicant's score would be:

$$MSQ = 4(1.5) + 3(2.5) + 2(2.0)$$

$$= 17.5$$

Optional Subject Quality Score

[4] $OSQ = 4(OSU_A) + 2(OSU_B) + (OSU_C)$

This applicant's score would be:

$$OSQ = 4(0.5) + 2(3.5) + (3.0)$$

$$= 12.0$$

High School Completion Score

As indicated in Table B-1, this typical NPS applicant graduated from high school and, therefore, HSC = 15. If he had failed to complete high school his score would have been zero.

STANDARDIZED TEST RESULTS

The test results of this typical NPS applicant are presented in Table B-2.

TABLE B-2

Standardized Test Data on A Typical NPS Applicant

Test Battery	Score
Cooperative School and College Ability Tests:*	
Verbal Ability:	
Raw Score (SVAR)	40
Converted Score (SVAC)	305
Quantitative Ability:	
Raw Score (SQAR)	40
Converted Score (SQAC)	318
College Entrance Examination Board:	
English Achievement (CBEA)	558
Mathematics Achievement (CBMA)	631
Scholastic Aptitude Tests:	
Verbal Aptitude (SATV)	551
Mathematics Aptitude (SATM)	627

*The relationship between raw scores and converted scores of the Cooperative School and College Ability Test is explained elsewhere (3, 4). For purposes of illustration, it is assumed that Form 1C of the SCAT was used.

CURRENT NPS SELECTION COMPOSITE

Computation of the Current NPS Selection Composite[2]

The Current NPS Selection Composite is computed using the following equation:

$$[5] \quad CSC = 2(MSU) + (OSU) + (MSQ) + (OSQ) + (HSC) + (SVAR) + (SQAR)$$

[2]Note that SCAT raw scores are used in computing CSC.

The CSC score of this typical NPS applicant is obtained by substituting the appropriate values from Tables B-1 and B-2 into Equation [5] as follows:

$$CSC = 2(6.0) + (7.0) + (17.5) + (12.0) + (15.0) + (40.0) + (40.0)$$

$$= 143.5$$

Prediction of Criterion Performance From the Current NPS Selection Composite

The weights applied to the operational predictors in computing CSC were determined by the NPS Selection Board. These are not the most effective weights for predicting performance on either of the criteria. If it were desirable, for any reason, to employ CSC in NPS selection decisions, the best available estimate of an applicant's final grade average in the NPS program would be:

$$[6] \quad FGA = .279\ (CSC) + 33.418$$

The best prediction of FGA for this typical applicant, using his CSC score, would be

$$FGA = .279(143.5) + 33.418$$

$$= 73.454$$

Again, assuming the desirability of employing CSC, the best estimate of an NPS applicant's chances of being admitted to USNA is computed as follows:

$$S/R = .009(CSC) - .649$$

For this typical applicant this is:

$$S/R = .009(143.5) - .649$$

$$= .642$$

This indicates that the best available estimate of the probability that this NPS applicant will be selected for USNA is .64, or 64 in 100.

OPTIMAL COMPOSITES OF OPERATIONAL PREDICTORS[3]

The optimal raw score weights for the operational predictors which would be used to predict each of the two criteria are presented in Table B-3.

TABLE B-3

Optimal Raw Score Weights for Predicting NPS Final Grade Average and USNA Selection vs. Rejection for NPS Applicants from Scores on the Operational Predictors

	Optimal Raw Score Weights	
Operational Predictors	FGA	S/R
MSU	---	---
OSU	---	---
MSQ	.404	.019
OSQ	.408	---
HSC	---	---
SVAC	---	---
SQAC	.341	.009
Additive Constants:	-46.111	-2.631

Prediction of NPS Final Grade Average

Use of the optimal composite for forecasting FGA requires information on three of the operational predictors: MSQ, OSQ, and SQAC. An applicant's scores would be entered into the following equation:

$$[8] \quad FGA = .404(MSQ) + .408(OSQ) + .341(SQAC) - 46.111$$

Using the typical applicant's scores, shown in Tables B-1 and B-2 above:

$$FGA = .404(17.5) + .408(12.0) + .341(318) - 46.111$$

$$= 74.293$$

The best prediction of this typical applicant's FGA is 74.

[3] Note that SCAT converted scores, rather than raw scores, are used in all optimal composites.

Prediction of USNA Selection vs. Rejection

The optimal composite for estimating S/R for an NPS applicant requires information on only two operational predictors: MSQ and SQAC. The actual equation employed is as follows:

$$[9] \quad S/R = .019\ (MSQ) + .009(SQAC) - 2.631$$

Using the scores of the typical NPS applicant:

$$S/R = .019(17.5) + .009(318) - 2.631$$

$$= .564$$

The best available estimate of the probability of this NPS applicant being selected for USNA program is .56. His chances of being accepted by USNA are about 56 in 100, slightly better than fifty-fifty.

OPTIMAL COMPOSITES OF OPERATIONAL AND EXPERIMENTAL PREDICTORS

The optimal raw score weights for the operational and experimental predictors which would be used to predict each of the criteria are presented in Table B-4.

Prediction of NPS Final Grade Average

Use of the optimal composite of operational and experimental predictors requires information on five predictors: MSQ, OSQ, CBEA, CBMA, and, SATM.

An applicant's scores would be entered into the following equation:

$$[10] \quad FGA = .202(MSQ) + .349(OSQ) + .012(CBEA) + .032(CBMA)$$

$$+ .036(SATM) + 17.202$$

The best prediction of this typical NPS applicant's final grade average is:

$$FGA = .202(17.5) + .349(12.0) + .012(558) + .032(631)$$

$$+ .036(627) + 17.202$$

$$= 74.385$$

This applicant may be expected to achieve a grade average of about 74 in the NPS program.

TABLE B-4

Optimal Raw Score Weights for Predicting NPS Final Grade Average and USNA Selection vs. Rejection for NPS Applicants from Scores on the Operational and Experimental Predictors

Predictor Variables	Optimal Raw Score Weights FGA	S/R
Operational Predictors:		
MSU	---	---
OSU	---	---
MSQ	.202	---
OSQ	.349	---
HSC	---	---
SVAC	---	---
SQAC	---	---
Experimental Predictors:		
CBEA	.012	.001
CBMA	.032	---
SATV	---	---
SATM	.036	.003
Additive Constants:	17.202	-1.772

Prediction of USNA Selection vs. Rejection

The optimal composite of operational and experimental predictors requires no information on the operational predictors and only includes

two of the four experimental predictors: CBEA and SATM. These test scores are entered into the following equation:

$$[11) \quad S/R = .001(CBEA) + .003(SATM) - 1.772$$

Substituting this typical applicant's test scores into this equation gives:

$$S/R = .001(558) + .003(627) - 1.772$$

$$= .667$$

The best available estimate of this applicant's probability of being selected for USNA is .67, or about two chances in three.

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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

Naval Personnel Research and Development Laboratory
Washington Navy Yard
Washington, D. C. 20390

2a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED

2b. GROUP:

3. REPORT TITLE

Prediction of Success in the U. S. Naval Preparatory School

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Interim

5. AUTHOR(S) *(First name, middle initial, last name)*

William A. Sands

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 1970	34	11

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. PF39.521.001.02.02	WRR 70-7
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	N/A

10. DISTRIBUTION STATEMENT

This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of the Naval Personnel Research and Development Laboratory.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
N/A	Personnel Research Division (Pers-A3) Bureau of Naval Personnel Washington, D. C. 20370

13. ABSTRACT

This is the first in a series of studies to assess and improve current procedures for selecting U. S. Naval Preparatory School (NPS) applicants. The average 82% attrition rate between NPS matriculation and graduation from the U. S. Naval Academy (USNA) represents an estimated annual loss to the Navy of between one and three million dollars.

NPS Final Grade Average (FGA) and USNA Selection vs. Rejection (S/R) were the two criteria employed. Operational predictors consisted of five measures of previous academic achievement and the SCAT tests. Experimental predictors consisted of the SAT and two CEEB achievement tests. Correlational and multiple regression analyses were performed in a sample of NPS applicants (N=246).

The Current NPS Selection Composite is fairly effective in predicting FGA (r = .643). Higher validity for predicting FGA was observed for two optimally-weighted composites: operational predictors ($_cR$ = .733); and, operational and experimental predictors ($_cR$ = .871). In predicting S/R, the Current NPS Selection Composite has moderate validity (r_{pb} = .402). Equal or higher validity for predicting S/R was found for two optimally-weighted composites: operational predictors ($_cR$ = .398); and, operational and experimental predictors ($_cR$ = .655).

Cross-validation of these promising results and validation against more ultimate criteria (e.g., success in USNA) are planned. Procedures for the implementation of regression composites are outlined.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
U. S. Naval Preparatory School						
U. S. Naval Academy						
Attrition						
Selection procedures						
Prediction of academic success						
Prediction of grade averages						
Multiple regression analyses						
Multiple discriminant function analyses						
Scholastic Aptitude Tests						
College Entrance Examination Board						
School and College Ability Tests						